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# Foreword

This special issue of Theoretical Computer Science is a collection of papers selected among those presented at the 2nd Conference on Cellular Automata for Research and Industry (ACRI) held in Milan (Italy) on 16–18 October 1996. The selection of the papers has been made in order to present not only theoretical research results about cellular automata (CA), but also more application-oriented contributions that illustrate a growing scenario of interests in the field of cellular automata.

The first three papers are dedicated to purely theoretical aspects of cellular automata. The next three illustrate some generalizations of the basic CA model, paying attention to their modeling power rather than to their formal properties, with examples of applications to biology and physics. Finally, the last two papers illustrate the application of computational models based on cellular automata to specific problems in different domains.

In particular, T. Worsch in his paper on "Parallel Turing Machines with One-Head Control Units and cellular automata" presents parallel turing machines (PTM) as a generalization of cellular automata (CA), and investigates their power as recognizers of formal languages, showing hierarchies of complexity classes which are completely contained in the class of languages recognizable in polynomial time by CA with space complexity $n$.

The contribution of G. Cattaneo, E. Formenti, L. Margara and G. Mauri ("On the Dynamical Behavior of Chaotic Cellular Automata") proposes a new topological definition of chaos for discrete time dynamical systems, which corresponds to the intuitive idea of chaotic behavior, and proves that, under this new definition, the shift dynamical system is no more chaotic. Furthermore, it is proved that essential transformations preserve the new definition of chaos and other aspects of the global qualitative dynamics of additive cellular automata.

In "Signals in One Dimensional Cellular Automata" J. Mazoyer and V. Terrier present a theoretical contribution regarding signals constructed by one-dimensional cellular automata, where the class of Fisher constructible functions is introduced and some critical examples presented. Moreover, the closure of this class with respect to elementary operations is proved and relations among the notion of Fisher constructibility, Turing space constructibility and recognizability by one-dimensional cellular automata are stated.


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M. Sipper and M. Tomassini, in "Computation in Artificially-Evolved, non-Uniform Cellular Automata", present an overview on non-uniform CA, focussing on the evolution of such systems to perform computational tasks, via a parallel evolutionary algorithm.

S. Bandini and G. Mauri show in "Multilayered Automata Networks" a hierarchical model of Automata Networks and Cellular Automata and the related dynamics particularly useful in modeling and simulating biological systems (cellular interactions in the immune system, calcium ion diffusion in living cells).

In their work ("Lattice Boltzmann Computations and Applications to Physics") B. Chopard and P.O. Luthi introduce a survey of some main features of Lattice Boltzmann models, and some paradigmatic applications to Physics (mobile communications, modeling solid body).

From more theoretical to an applicative perspective, S. Di Gregorio, R. Serra and M. Villani in "Applying Cellular Automata to Complex Environmental Problems: the Simulation of the Bioremediation of Contaminated Soils", and F.A. Bignone in "Coupled Maps Lattice Dynamics on a Variable Space for the Study of Development: a General Discussion on Caenorhabditis Elegans" present, respectively, a macroscopic cellular automata model for simulating the bioremediation of contaminated soil, and a reconstruction of living cellular dynamics with coupled maps lattices or Lindenmayer grammars formalizations. The hierarchical model proposed in the former allows to represent a fluid dynamical layer, a solute description layer and a biological layer, and in the latter the Nematode worm (Caenorhabditis Elegans) development up to the level of hatching is described.

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